551.590.2

SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING MAY, 1917.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., June 27, 1917.]

For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1917, 45:2.

The monthly means and departures from normal values in Table 1 show that direct solar radiation averaged below its normal intensity at all the stations except Madison, Wis., where it was very close to normal.

At Washington hazy conditions prevailed from May 9 to 28, inclusive, and were specially marked from the 16th to the 18th, inclusive. Between these latter dates a smoke cloud that originated from forest fires in Minnesota advanced from the Upper Lakes region to the middle Atlantic coast. The low radiation intensities at Washington, and probably also at the other stations, are to be attributed to the prevailing atmospheric conditions.

TABLE 1.—*Solar radiation intensities during May, 1917.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
May 2	.....	1.29	1.17	1.06	0.96	0.86	0.79	0.74	0.69	.....
9	.....	.....	0.58	0.54	0.49	0.45	0.41	0.37	0.34	0.31
10	1.25	1.09	0.93	0.77	0.66	0.59	0.54	0.49	0.45	.....
11	.....	1.08	0.86	.....	.....	.....	.....	.....	.....	.....
15	1.12	1.07	0.88	0.72	0.59	0.52	0.47	0.43	0.40	.....
16	.....	0.72	0.57	.....	0.40	0.37	.....	.....	.....	.....
18	0.90	0.54	0.40	.....	.....	.....	.....	.....	.....	.....
23	1.24	1.07	0.92	0.89	0.82	0.75	0.68	0.63	.....	.....
24	.....	.....	0.62	0.54	.....	.....	.....	0.31	.....	.....
26	1.41	1.24	.....	1.00	0.92	0.85	0.78	.....	.....	.....
30	.....	.....	0.98	0.90	.....	.....	.....	.....	.....	.....
Monthly means	1.18	1.01	0.79	0.80	0.69	0.63	0.61	0.50	0.47	(0.31)
Departure from 9-year normal	−0.12	−0.11	−0.18	−0.09	−0.08	−0.06	−0.08	−0.05	−0.02	−0.11
P. M.										
May 1	.....	1.22	1.13	1.05	0.97	0.89	0.82	0.76	0.70	0.64
2	.....	1.23	1.04	.....	.....	.....	.....	.....	.....	.....
15	.....	0.87	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	0.61	0.54	0.41	.....	0.32	.....	.....	.....	.....
23	.....	1.26	1.17	1.08	1.00	0.93	0.86	.....	.....	.....
25	.....	1.00	0.74	0.62	0.52	.....	.....	.....	.....	.....
Monthly means	.....	1.03	0.92	0.79	0.83	0.71	(0.84)	(0.76)	(0.70)	(0.64)
Departure from 9-year normal	.....	−0.09	−0.06	−0.04	+0.05	−0.01	+0.10	+0.12	+0.07	+0.16

TABLE 1.—*Solar radiation intensities during May, 1917.*

Madison, Wis.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
May 2	.....	.....	.....	.....	0.97	.....	.....	.....	.....	.....
5	.....	1.33	1.24	1.15	1.06	0.98	.....	.....	.....	.....
7	1.39	1.30	1.22	1.12	1.04	0.94	.....	.....	.....	.....
9	.....	1.24	.....	1.00	0.89	.....	.....	.....	.....	.....
10	1.23	0.89	.....	.....	.....	.....	.....	.....	.....	.....
11	1.47	1.31	.....	.....	.....	.....	.....	.....	.....	.....
12	1.40	1.22	.....	0.89	0.80	.....	.....	.....	.....	.....
14	.....	1.16	1.08	0.98	0.90	.....	.....	.....	.....	.....
23	1.26	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	1.28	1.03	0.83	.....	.....	.....	.....	.....	.....	.....
25	1.29	1.23	1.10	1.00	0.90	.....	.....	.....	.....	.....
28	.....	.....	0.79	0.67	.....	.....	.....	.....	.....	.....
29	.....	.....	0.71	0.60	.....	.....	.....	.....	.....	.....
Monthly means	1.33	1.19	1.00	0.93	0.94	(0.96)	.....	.....	.....	.....
Departure from 7-year normal	+0.01	−0.01	−0.06	−0.02	+0.03	+0.09	.....	.....	.....	.....
P. M.										
May 7	.....	1.26	1.10	.....	.....	.....	.....	.....	.....	.....
9	.....	1.28	.....	1.01	.....	.....	.....	.....	.....	.....
Monthly means	.....	(1.27)	(1.10)	(1.01)	.....	.....	.....	.....	.....	.....
Departure from 7-year normal	.....	+0.21	+0.17	.....	.....	.....	.....	.....	.....	.....

Lincoln, Nebr.

A. M.										
May 5	.....	1.35	1.22	.....	.....	.....	.....	.....	.....	.....
6	1.41	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	.....	1.30	1.14	1.04	0.96	.....	.....	.....	.....	.....
11	.....	1.16	1.04	.....	.....	.....	.....	.....	.....	.....
14	1.22	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	1.19	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.21	1.06	0.88	0.77	0.72	0.68	.....	.....	.....	.....
17	1.36	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	1.18	1.03	0.90	.....	.....	.....	.....	.....	.....
31	1.18	1.03	.....	.....	.....	.....	.....	.....	.....	.....
Monthly means	1.26	1.18	1.06	0.90	(0.84)	(0.68)	.....	.....	.....	.....
Departure from 2-year normal	−0.08	−0.09	−0.10	−0.14	−0.14	−0.21	.....	.....	.....	.....
P. M.										
May 15	.....	1.01	0.87	0.75	0.66	0.58	0.52	.....	.....	.....
16	.....	0.98	0.70	.....	.....	.....	.....	.....	.....	.....
17	.....	1.10	1.00	0.85	0.75	0.65	.....	.....	.....	.....
22	.....	1.29	.....	.....	.....	.....	.....	.....	.....	.....
31	.....	0.94	0.76	0.67	0.62	0.57	0.52	.....	.....	.....
Monthly means	.....	1.06	0.83	0.76	0.68	0.60	(0.52)	.....	.....	.....
Departure from 2-year normal	.....	−0.10	−0.15	−0.10	−0.09	−0.10	−0.13	.....	.....	.....

Skylight polarization measurements at Washington give a mean of 48 per cent, with a maximum of 62 per cent on the 23d. These values are only slightly below

May averages for Washington. Measurements at Madison give a mean of 54 per cent, with a maximum of 64 per cent on the 5th.

Table 3 shows a deficiency in the total radiation for the month of 7 per cent at Washington and an excess of 10 per cent at Madison.

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D.C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	A.M.	P.M.	Dates.	A.M.	P.M.	Dates.	A.M.	P.M.	Dates.	A.M.	P.M.
1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*
May 1	10.21	4.75	May 2	4.95	3.99	May 5	4.57	7.29	May 1	3.15	1.07
2	4.17	3.99	5	3.15	4.17	6	4.17	4.17	2	2.62	2.16
9	6.50	3.99	7	4.37	3.99	7	4.37	4.17	16	4.57	1.88
10	4.57	4.37	9	4.75	4.17	11	6.27	4.75	17	3.00	1.68
11	6.27	3.99	10	3.99	4.17	14	5.16	4.17	26	3.45	3.99
15	5.36	3.00	11	4.37	4.95	15	5.16	4.75	28	3.63	1.60
16	7.29	5.66	12	4.57	5.36	16	5.56	7.87	31	3.15	3.45
18	9.14	9.14	14	5.36	7.04	17	10.97	7.29	.....	.....	.....
23	13.13	4.17	23	2.87	4.57	22	6.02	4.17	.....	.....	.....
24	5.56	3.81	24	3.63	5.79	28	7.04	8.81	.....	.....	.....
25	5.16	4.95	25	6.02	6.76	31	8.48	9.14	.....	.....	.....
26	5.56	9.14	28	6.02	5.79	.....	.....	.....	.....	.....	.....
30	7.87	9.14	29	7.57	9.83	.....	.....	.....	.....	.....	.....

TABLE 3.—*Daily totals and departures of solar and sky radiation during May, 1917.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
1917.	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*
May 1	444	372	.....	−23	−82	.....	−23	−82	.....
2	630	563	.....	161	107	.....	138	25	.....
3	547	528	.....	75	71	.....	213	96	.....
4	90	314	.....	−385	−144	.....	−172	−48	.....
5	52	389	.....	−426	−70	.....	−598	−118	.....
6	394	367	.....	−86	−93	.....	−684	−211	.....
7	326	696	.....	−154	235	.....	−838	24	.....
8	190	501	.....	−295	40	.....	−1,133	64	.....
9	429	684	.....	−58	222	.....	−1,191	286	.....
10	538	651	.....	49	188	.....	−1,142	474	.....
11	563	702	.....	72	238	.....	−1,070	712	.....
12	488	614	.....	−5	150	.....	−1,075	862	.....
13	574	697	.....	79	232	.....	−996	1,094	.....
14	623	649	.....	126	183	.....	−870	1,277	.....
15	690	605	.....	191	139	.....	−679	1,416	.....
16	479	662	.....	−20	195	.....	−699	1,611	.....
17	408	593	.....	−91	125	.....	−790	1,736	.....
18	589	577	.....	90	108	.....	−700	1,844	.....
19	606	610	.....	108	140	.....	−592	1,984	.....
20	502	537	.....	4	67	.....	−588	2,051	.....
Decade departure							554	1,577	.....
21	516	55	.....	19	−416	.....	−569	1,635	.....
22	406	200	.....	−90	−272	.....	−659	1,363	.....
23	546	712	.....	50	239	.....	−609	1,602	.....
24	526	713	.....	30	239	.....	−579	1,841	.....
25	427	683	.....	−68	208	.....	−647	2,049	.....
26	596	136	.....	102	−340	.....	−545	1,709	.....
27	516	540	.....	22	62	.....	−523	1,771	.....
28	156	692	.....	−337	213	.....	−860	1,984	.....
29	236	594	.....	−256	113	.....	−1,116	2,097	.....
30	680	123	.....	189	−359	.....	−927	1,738	.....
31	376	243	.....	−114	−241	.....	−1,041	1,497	.....
Decade departure							−453	−554	.....
Excess or deficiency since first of year. Gr.-cal.							−2,541	+2,172	.....
Excess or deficiency since first of year. Per cent.							−5.0	+4.4	.....

NOTE.

There is evidence that the records of total solar and sky radiation at Lincoln, Nebr., and of the intensity of direct solar radiation at Santa Fe, N. Mex., are inaccurate. Publication of these data is therefore deferred until the instrumental constants have been redetermined.

551.591

CITY SMOKE AND DAYLIGHT ILLUMINATION INTENSITIES.

By HERBERT H. KIMBALL, Professor of Meteorology, and ALFRED H. THIESSEN, Meteorologist.

[Weather Bureau, Washington, May 24, 1917.]

One of us [1] has already called attention to the considerable diminution in daylight illumination, especially in winter, in cities where soft coal is burned, due to the presence of smoke in the atmosphere. At Salt Lake City, Utah, this effect is specially marked in the early morning hours, and when the wind is light it sometimes persists for a considerable time. In order to determine the extent of the diminution, photometric measurements were made by Mr. Thiessen with the Sharp-Millar photometer described in the MONTHLY WEATHER REVIEW for December, 1914, **42**:648–653, the instrument having been lent him by the central office of the Weather Bureau for this purpose.

In this study a comparison is made between the readings obtained at Salt Lake City on four different days, as follows: February 15 and 16, 1916, which were cloudless, but with much smoke in the atmosphere, and September 1 and 28, 1916, on which neither cloud nor smoke was observed. The readings are given in Table 1.

It will be noticed that each series of readings usually includes three independent photometric determinations. The mean of each series has been reduced to foot-candles of illumination by a factor derived from the constants given in the REVIEW for December, 1914, **42**:650. The milk glass screen and blue glass VIA, there described, have always been used. Column 4 of Table 1, headed "Scr.," indicates when screen *L* or *D* has also been used.

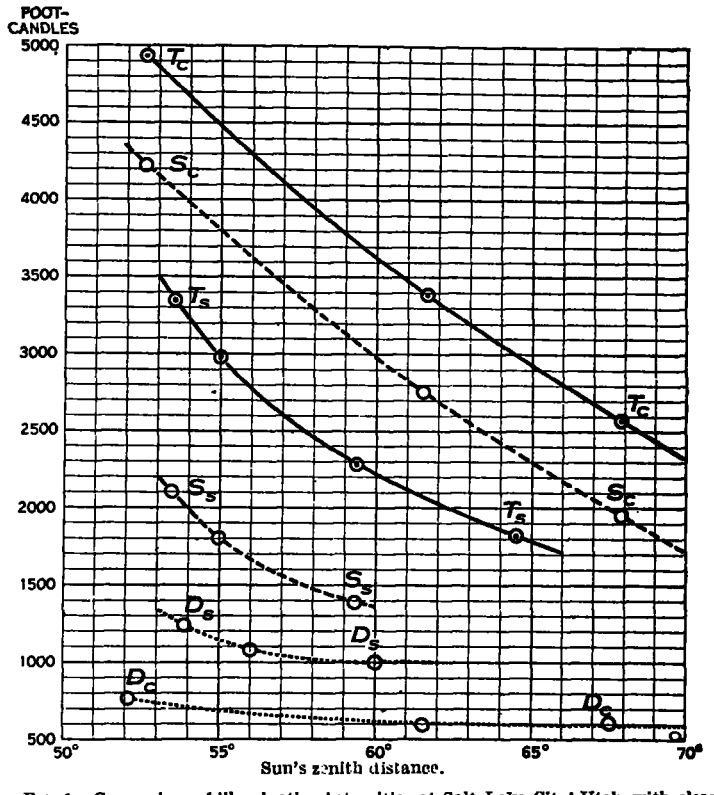

FIG. 1.—Comparison of illumination intensities at Salt Lake City, Utah, with clear and with smoky sky:

——— { T_c = Total illumination, with clear sky;
{ T_s = Total illumination, with smoky sky;
– – – { S_c = Direct solar illumination, with clear sky;
{ S_s = Direct solar illumination, with smoky sky;
····· { D_c = Diffuse sky illumination, with clear sky:
{ D_s = Diffuse sky illumination, with smoky sky.

[1] *Kimball, Herbert H.* The meteorological aspect of the smoke problem. Smoke Investigation Bulletin No. 5, Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburgh, 1913; also MONTHLY WEATHER REVIEW, anuary, 1914, 42:29–35.